

*An Abstract of a Letter of Mr. Leeuwenhoeck
Fellow of the R. Society, dated March 30th. 1685.
to the R. S. Concerning Generation by an In-
fect.*

A Bout the latter end of the Summer of the year 1683. I took the *Semen Masculum* of a *Dog*, which was of about a year and half old. This I put into a Glasse pipe, and wrapt it up in soft leather, because the nights were something cold. This *Semen* I observed 4 days successively, and in the first, I found that severall of its Animals were dead. In the 2d and 3d day, there were yet more of them dead, but on the 4th, there were very few left alive; and so far I proceeded at that time. But in the beginning of *October* in the year 1684. I observed again the *Semen Masculum* of the same *Dog*, who was then very strong and Vigorous, and I found that after 7 days and nights, there were some few Animals yet left alive; a very few whereof swam as briskly as if they had just come from the *Dog*.

From hence I inferr, that these Animals, would have lived a much longer time, if they had been in the *Uterus*: also that Conception in *Females* is not always made *immediate post congressum*, but sometimes 9, or 10, or more days after it, if one of the Animals can then find the *Punctum* or proper place for its Nourishment: and lastly that the *Uterus* may not be fit for the Reception of Animals at one time, tho' before 2 or 3 days are past, it may become perfectly capable.

I know my Opinion about *Generation* has been rejected by several persons, some whereof being skilled in Anatomy have affirmed to me, that the *Semen Masculum* never comes into the *Uterus*; that its never to be seen in that place; and that its nothing but a *Vapour* which causes fruitfulness. But I am not of these mens minds, for it seems plain to me, that the parts are proportioned
by

by Nature for the carrying the *Semen* into the *Uterus*. And therefore *Wolves*, *Foxes* and *Dogs* are fastned, and tho' the *Dog* at first sheds a little thin clear moisture, yet that is not a true *Semen*, for I could not find any Animals in it. But as he is fastned, there drops very leasurely a little *Semen* which is *white*, by reason of the great number of Animals contained in it: and this would not reach the *Uterus*, (because of its coming so slowly, and of the swelling of the *Penis*,) unless the *Dog* were fastned.

I remember that Dr. *Grew* formerly Secretary of the *Society*, in a letter to me, used some words to this purpose. Your *Harvey* in his Book *de Generatione Animalium* denies that he ever found in the *Uterus* Anatomised immediately after conception, the *Semen Masculum*. And our Dr. *de Graaf* in his Book *de Partibus Muliebribus Generationi inservientibus*, constantly asserts, that the *Semen Masculum*, is nothing but a Vehicle of a certain Volatile Salt, or such like spirit, conveying to the Egg of the Female a *Contactum Vitalem*.

But tho' a late Writer has reckoned up the Authorities of 70 Persons, who have asserted the same Opinion, and that of the *Ovarium*, yet I think they have been all mistaken. As will appear by the following Tryals.

I bespoke a *Bitch* of an ordinary size, to be delivered to me after she had been once lined, which hapned to be the 30th of *December* last, upon the next day at 8 of the Clock in the morning, the *Bitch* was lined again, in my presence, and again at 2 a Clock in the afternoon, whereupon I caused her to be killed by running an Awl into the *Medulla Spinalis* near the head. As soon as she was dead, I bound her legs to a Table, and opened the *Vagina*) where I found a white substance, which I took out & viewed with my Microscope, discovering it to be nothing but Scales (of that sort which cover the inside of the *vagina*) lying in a clear thin liquor.

Afterwards I opened the middle of the *Cornu* on the

left side, which was about 3 inches $\frac{2}{3}$ long, and as thick as a good quill, as at *K*. If I had only looked with my naked Ey, I should have said there had been no *Semen* (of a *Dog*) in it, but when I made use of a very good Microscope, I saw to my great satisfaction, a very great number of the living Animals of that *Semen*.

I then opened the *Cornu* towards the end as at *L*, and saw there likewise a good quantity of the *Semen*, which was very lively.

I opened the *Cornu* on the right side, and found a like number of the living Animals.

Then I opened that part of the *Uterus* which is between the *Vagina* and the *Cornu* as at *H*. which part was 1 and $\frac{2}{3}$ of an inch long: and here I found in the stuff lying on the inside of the *Uterus* a greater number of the living Animals then before, and I cannot think they were less then a hundred Millions.

After 3 and $\frac{1}{2}$ hours time, I went to communicate this my Discovery to an Eminent Physician, and Anatomist who could not be of Dr. *De Graafs* opinion about the descent of the Eggs out of the *Ovarium*, tho' he had been present at his Dissections. In his presence I opened the *Uterus* in another place, and shewed him the substance contained therein, having in it a great number of the living Animals of the *Semen Masculum*, tho' the weather was very cold and freezing, I likewise shewed him one of the *Plexus* commonly call'd the *Ovarium*, wherein were severall bloody spots caused by the breaking of some of the Water bladders or glandulous particles whereof they consist: which broken water bladders were still included in a very strong Membrane; the said Physician remaining convinced that Generation was more clearly explained after my way, then by Eggs suck'd out of the *Ovarium*.

I opened the *Vagina Uteri*, and caused it to be so drawn together with the *Uterus*, and *Ovarium*, or *Testicles*;

cles; the *Vagina* and *Uterus* have not the full length given them, because they should not take up too much place upon the Paper, but their breadth is true. The *Ovarium* with the glandulous particles, and water bladders, are of the same bigness as they appeared.

I suppose this figure may be spoke against by Anatomists, because it is not layd out according to Art, but I don't pretend to Anatomy, for I never saw a *Uterus* taken out except by my self, or by a Butcher.

Fig. 1. ABCD. is the *Pudendum* of a Bitch opened.

DEFG. is the *Vagina Uteri* open'd which was 5 Inches long. This I first examined in the middle about *F.* to see whether there were any of the *Semen Masculum* in that place, but I found none at all, but instead thereof a great deal of Scales, which in all likelihood belonged to the inward Skin of the *Vagina*, and were worn off; also severall Globules of that sort which makes the blood red, and a great many globules of a lesser sort.

I then examined it about *E*, but I found no other substance, but what I have now described.

Lastly I examined it about *G*, close by the *Uterus*, and I found very few Animals, but the Scales were there very plentifull, being at least 25 Scales to one Animal.

These last Animals I suppose were only such as were scatter'd in the way, when the *Penis* of the *Dog* was drawn out.

From these observations may be concluded, that not the *Vagina* but the *Uterus* it self is made for the reception and inclosing of the *Semen Masculum*; least the Animals should swim back, and come into the sheath, which would be unprofitable ground; for the Animals were swam forward in the *Uterus* 5 inches and $\frac{1}{2}$ which is the distance from *GHIK* to *L*, and this way (by a rough calculation which I have made of their swimming) I suppose they might get over in about 40 minutes.

I opened likewise the whole length of the *Uterus*, as *PQ* seeking for the bodies, which they say are sucked from

the *Ovarium* in Generation, but as I expected I found none. For if it be layd down, that the greatest Eggs are the ripest, (as it is in all Animals that are Oviparous) I should not have had much trouble to discover them, if they had continued so great round bodies as those in the *Ovarium* *L M N O*, or such bodys as are represented in the *Ovarium* *Q R S* which is but half its bigness.

The *Uterus* of a *Bitch* is from *I K* to *L* almost of an equall thickness, but at *L* it becomes immediately very small (contrary to the *Uterus* of a *Sheep*) and how is it to be comprehended, that so great round bodys as the Eggs, can pass thro' so narrow and wrinkled a Passage, and not only one of them, but severall together; as in a *Bitch*, which being but once lined, brings severall Puppy's. That I might satisfy my self herein, I separated the thinnest part of the *Tuba* from the *Testicle* (for otherwise the length and end of it is not to be seen) and bound a thread about the *Tuba* where it grows thick; partly that in the mouth that sucks down the supposed Eggs, (where I have put a great Pin to shew the Cavity) I might pour Quick-silver for the discovering how much the thin stiff *Tuba* would stretch it self; and partly that I might know whether the round Membrane which contains it, and reaches from *L*, to *O*, as *O N* had a hollowness.

Fig. 2. VWX. is the thin end of the *Tuba*.

T. is the thread bound about the thick part of the *Uterus*.

X, is the opening where the Quick-silver is put in.

The *Tuba* did not stretch it self any wider then is here represented, nor did it loose that krinkled form which it had while it was in the *Ovarium* as is represented at *W*.

The *Uterus* at *T V* stretcht it self very much by reason of the Quick-silver, and from thence I am ascertained that it hath no other Passage then at *X*. for if it had, the Quick-silver would have run out of it.

Here hence will appear the impossibility that the great Glandulous

Glandulous bodys in *LMNO*, and *QRS*, should go thro' the small Passage *XWV* in *Fig. 2d.* till they come to the widening of the *Uterus*; and I must confess (tho' this *Bitch* was as likely as any could be wisht) I could not find any round particle in it, that was bigger then a Globule of the blood, which makes it red.

About the middle of *January*, I procured another *Bitch* which had been Proud 3 days, in which time (they said) she had been lined thrice, and when she had been lined a fourth time in my presence, I opened the *Uterus* in the same manner as I had done the other. But tho' I found a great quantity of the *Semen Masculum*, I could not find any body bigger then a Globule that makes the blood red; and if there had been any thing so big as the $\frac{1}{100}$ part of a Sand, I doubt not but I should have discovered it.

Likewise in the *Vagina Uteri*, there was nothing but what I have formerly mentioned.

I understand that Dr. *De Graaf*, when he Anatomised female Rabbits, used to judge how many young would next have been brought forth, by the number of red specks in the *Ovarium*, tho' none of the Eggs were to be found in the *Uterus*. He was also of the Opinion, that the Eggs first came down in the *Uterus*, 4 days after the female had taken the Buck. But its strange that Rabbits should be compleatly made in 30 days, and yet the Eggs first be seen in $7\frac{1}{2}$ parts of the time.

In the year 1678. I sent your Honours, the draught of one of those numerous Animals, which are in the *Semen* of a *Dog*, noting that they are so small that 1000000 are not equall to a course Sand, I shall here again insert the same figure, that you may see how I imagine these Animals came to be round in the *Uterus*.

I need not mention how severall Insects cast their skin, and how Tadpoles as they grow in bigness, loose their Tails, and appear to be Frogs.

Fig. 3. EFGH. is one of the Animals of the *Semen* of a *Dog*, as I saw it swimming.

Fig. 4. IKLM is one of the Animals when its dead. I have often observed these last Animals to change their figure, chiefly when the moisture wherein they live, and swim, is exhaled.

When one of these Animals has got so far in the Womb, that it finds a place fit to nourish it, then may it suddenly cast off its Tail, or its whole outward covering, and remain of an Ovall form, as *Fig. 3. FGH.* or *Fig. 4. IKL.*

Again we find that the Bodys of Animals, while they are in the Womb, are so bound together, that they appear round. This is daily seen in larger Animals, and is undoubtedly the same in Insects.

I likewise am perswaded, that no Animal is changed or casts his Skin, without there be another Skin left to cover his body. This we find in Cater-Pillars, which as soon as they are come to their growth, and have spun their Case, they change not only their first Skin, and become a *Chrysalis*, but are yet encompassed with another Skin; and thus I believe it is with the *Animalia Seminis Masculi*, for they no sooner loose one of their *Membranæ* or Coats, but there remains another, which continually encompasses the *Fetus*, and grows together with it, till it comes to a Birth.

Its supposed that Animals while they grow in the Womb, have a living Soul; now if this be so, its a thousand times more likely, that the Soul which is in the *Animalia Seminis Masculi* should still remain there, changing only their outward shape, then that they should pass into another body.

I am also perswaded, that the living Soul which is in an Animal of the *Semen* of a *Cock*, does not loose it self in the parts of the Egg; but the parts of the Egg pass into the living Animal; so that the Egg of the Hen serves only to nourish and feed the living Animal. like-

Likewise I believe, that what is called frigidity in some men, is either a want (in them) of the *Animalia Seminis*, or a weakness in the Animals which renders them unable to live long in the Womb. And to this purpose I was lately informed of a Person, who tho' he had formerly had Children, wanted now the *Animalia Seminis*, which might be the reason of the present defect.

If this be true then, that a *Fetus* is an *Animal Seminis Masculi*, we may reject the Vulgar Opinion, that a Conception comes to be Male or Female according to the prevalency of one Seed above the other, since the *Animalia Seminis* are themselves of both Sexes.

In the beginning of February I received from a Butcher, the *Uterus* of a Sheep, which had taken the Ram 17 days before (as they said) I found in one of the *Cornua* thereof, a small body wrapt up in Membranes of a red fleshy colour. But being not able to distinguish its figure, tho' I put it in a Glas Tube about the thickness of a goos quill, together with Oyl of Turpentine; I took it out of the Glas again, and as it lay round, I gently stretcht it out in length, at which time I plainly saw the back bone, likewise blood Vessels lying thereby, and sending forth several branches, also in 2 distinct places the *Medulla Spinalis* lying in the Back bone. And in the head, I saw not only the *Maxilla* but the Muscles that covered them, and the Vessels lying in them, tho' they were not yet red and lookt like sinews. Likewise the Brain, and the small blood Vessels therein, the Eys that were about the bigness of a course Sand, but as clear as Chrystal; I opened the Belly and took out severall pieces of the Bowels, which were transparent, and about the size of a small hair. I saw severall strings of flesh, which I took to be the Muscles: when I cast my Ey on the Breast to see the Ribbs, I found the place so full of blood vessels, that there was nothing else to be taken notice of.

This whole Animal I judged to be no bigger then yth part

Y y

part of a Pea. And if so small a creature be furnisht with all its parts, there can be no reason to doubt, that the same creature has them, tho' he be a thousand times less, and the parts are not distinguishable by the sight. And if an Insect has limbs and Bowels, tho' it is not a thousand Millionth part so big as a sand, then may the *Animalia Seminis*, have likewise the same Limbs and bowells, which the *Fetus* has when it is brought forth.

Furthermore I took out of the Ovarium which was on the same side where the *Fetus* lay, 2 round red globulous bodies, commonly called Eggs, each whereof was about the bigness of a Pea, and consequently each Egg was about 8 times as big as the foresaid whole Animal.

These supposed Eggs, tho' I took them from between Membranes, were each wrapt in a Skin, or Membrane, that had blood Vessels running upon it; and when I opened the Eggs, I found they consisted chiefly of a Glandulous substance, and every glandule likewise consisted of other lesser glandules.

I bought a female Rabbet and let it take Buck 3 times in my presence, (which was quickly done) and then killed it, but did not open the womb, till a quarter of an hour after; about an Inch from the beginning of one of the Horns, I found a little fluid matter containing some few living Animals of the Male seed, but in the parts where the *Cornu* joyns to the *Vagina*, the living Animals were very numerous; in the middle of the *Cornu* and toward the further end, there were no Animals at all, nor any thing to be seen but a few blood globules swimming in a little fluid matter. The reason why the *Animalia Seminis* were not throughout the *Cornu*, I believe may be, that the Seed had not been long enough in the Womb, and therefore the Animals had not time to disperse themselves all over it.

The other Horn, being yet untoucht, I wrapt it up in a piece of Paper, and put it in a small Box which I carried
in

in my Pocket (because it was cold weather) from 9 a Clock in the morning (that I made my first Observations) till 3 afternoon, at which time I opened it, but found it little differing from the other horn, either in the Number of the Animals, or in their progress therein.

I opened the Womb a little below the Horns, and found a greater number of the *Animalia Seminis* than I had yet seen; but in the outermost part of the *Vagina* there were no Animals at all.

In both the horns layd open, I could find no round body bigger than a blood globule.

I then endeavoured to discover the make of the Animals, but it proved a work of great difficulty, yet I saw (after many observations) that their bodys are not Ovall, but flattish, *Fig. 5.* *ABC.* is the body of a dead Animal of the Male Seed of a Rabbet, which I had taken out of the Womb of the Female. In the foresaid bodys there oftentimes appeared 6 bright risings of a Globular form, placed after the manner they are here drawn, but the bright rising or Globule nearest the Tail was generally bigger than the rest, as it is represented at *C.* Tho' some of the bodys were without these Globules, yet I could sometimes perceive that at the Tail.

CD. Is the Tail lying in Bends, as it usually is when the Animal swims.

In any of the severall Seeds which I have observed I cannot say that the Animals are ever at rest, as long as there is any fluid matter left to move in, but their motion is continuall, till it decreases gradually as they come to dy.

There are some Animals which have also a small globular substance in the Tail, but it is not to be discovered without great attention.

Fig. 6. *EFG.* is the body of an Animal, having
Y y 2
only

only one Globule at the Tail, and another in the Tail.
G H. is the Tail of the Animal.

I have said That the Male Seed of the Rabbet was in the beginning of the Horns, but not throughout, as in Bitches; that I might be sure of this Observation, I let a Female Rabbet take Buck twice in half an hour time, and then let her live 6 hours after, at which time I kill'd her, in the presence of a Physician, who had been a Companion of Dr. *De Graaf* in his Anatomising of Rabbits. When I had taken out the Womb, with the Appurtenances, I opened one of the Horns in 3 several places, at the beginning, in the middle, and at the farther end; and took out of each place some of the stuff, which I shewed him in a Microscope, satisfying him, that the living Animals of Seed were throughout the Horns, and did not only move, but discover the distinct motion of their Tail.

I shewed him likewise the supposed *Ovarium*, in which were no red spots, but a great many water bladders as big as a pins head: for which he was very thankfull, desiring only to be convinced, that the Animals he had seen, are the same which come from the Seed of a Buck Rabbet, which I have promised to do, both from the *Vasa deferentia*, and the Testicles.

I likewise upon his desire, shewed him the stuff contained in the water bladders, which was nothing but a transparent moisture mixt with some blood globules.

The other Horn of the Womb being not then opened, I layd it in a Box on a moist paper for 16 hours, and then I found in it a great many living Animals. But in one place there were 25 dead for one alive, and in another place 100 dead for one alive. After 5 hours more, I lookt again, but then the Animals were all dead.

My intention had been formerly to prosecute in *Bitches* my inquiries about Generation, But I found them not so convenient as Rabbits. First, because *Bitches* are harder to come by at all times, and again because they are proud

8 or 10 days together, which makes it difficult to know how many days they have been with whelp; whereas Rabbits after they have been Buckt, are quiet in a few hours.

I therefore again put a Rabbit to Buck, and after 2 full days kill'd her, searching all the Horns of the Womb, and finding only a few Animals, but nothing else remarkable, saving that there were no Eggs; some round particles lay here and there, but they were 1000 times less then a Sand. I saw likewise some blood Vessels in the *Cornua* which were so small, that a blood Globule could not pass thro' them, without being broke into 64 parts. When I lookt on the *Ovarium* with my naked Ey, I thought I saw 8 or 9 red spots in it, but when I lookt with a common Microscope, I saw they were water bladders one redder then another, and containing some bloody matter, which consisted of small Glandulous parts, joyned together with Membranes, having many Globules of blood spread among them, whereby one of them was become blood red.

Afterwards I killed a Rabbit which had been Buckt 6 days before, and when I opened one of the *Cornua Uteri*, I saw therein a round water bladder about the bigness of a Barly corn, having a tender Membrane, seeming to be made of Globular parts, and shewing thro' a common Microscope like the grain of Shagrin; this I imagined to have come from an Animal of the Male Seed, but when I opened it, and searcht thro' all the watery stuff that it contained, I could make nothing of it, but that I thought I saw something having the form of a Rabbit, but a 1000 times less then a Sand. Yet I cannot be positive, since in the other Horn of the Womb, I found 2 such round bladders which had not the same appearances: tho' its probable an Animal might have harboured therein.

When the watery stuff began to evaporate, I saw a great number of six sided figures, whose sides rose up Pyramidally

(like those described in my last letter Numb. 3. *Fig. 4.* where I spoke of Allum) being clear as a polish'd Diamond: about them lay brown Globules, pretty to look on, especially in the Evening, when the light of a Candle passing thro' them, makes a glistering. The greatest of these Salts would cover a hair of ones head; but the least could not be distinguish'd by a Microscope that magnifies a hair to the thickness of ones finger, and from hence may be judg'd the smallness of some Salts produced in this moisture. There were likewise some Salts having a square Basis, and others an Oblong, but their number was few and scarce worth taking notice of.

The preceding Observations were made in a moderately dry season, but 2 days after when it was rainy weather, I lookt for the same Salts, but they were melted, and run among the brown Globules.

I examined the *Ovarium*, and found in it 2 or 3 water bladders which lay deep and were half hid, and one that was reddish, the rest that stuck out more, being the greater number, were of an ash-colour and consisted of Glandulous parts. I lookt also how the Eggs might have a Passage to come down, but could find none.

I received from a Butcher, the *Uterus* of a Sheep which was said to have taken the Ram 3 days before, as I opened each of the *Cornua*, the moisture run plentifully out, which I put separately in 2 Dishes, searching with my common Microscope till I found a small body of about the bigness of a course Sand. At first I could perceive no figure it had, but when I apply'd it to a good Microscope, it proved to be a young Lamb, with the head and back bent forward, but in very good Order: the jaw bone and Eys, were very distinct, but the back bone much less. I intended to have shewen the Animal to some Learned Men, but in handling it, I had the misfortune to bruise its head, which made the parts thereof indistinct, and when I separated the body, the Bowells dried

dried so fast, that I could see only a piece of them. The little Creature had no blood particles about it.

From all the preceding Observations, I am more and more confirmed, that the supposed *Ovariums* are only Instruments for the disburthening the parts thereabout; for if they were true *Ovariums*, the Eggs would first be little when the Animals are young, and grow bigger & bigger against the time that the Animals come to procreate. As it is in Birds that lay Eggs. That I might satisfy my self and others herein, I examined Calves of 3, 4, 5, and 6, weeks old, and shewed (in the presence of 4 Physicians) the Eggs as big as if they had been of a full grown Cow, for they were like peas.

Again I made appear, that the Eggs in a sucking Lamb, were as big and bigger than in a full grown Sheep; and the Glandulous parts and water bladders as many.

I have been often considering, whether the opening of the *Tuba* might not be to give way for the evacuating some moisture at the time the *Uterus* is closed, and which cannot get thro' the *Vagina*, for I have sometimes found in the thin part of the *Tuba* near the Opening, a white stuff consisting of transparent Globules a little bigger than a blood globule.

There lately came to my hand a Book called *Collectanea Medico Physica*, in which Cent. 5. pag. 8. are some words to this purpose. *But its most surprising what the learned Boutekoe relates from the Curious Leeuwenhoeck, that the Sperm of Men is full of small Children, and so the Sperm of other Animals according to their kind.*

But this is a mistake, for I have only said its full of Animals, or Worms, with long Tails, whose figure I have often shewn. For as it is not proper to say, that Worms swimming in the water are flying Insects, tho' they come from them; or to say that the Kernel of an Apple is a tree, tho' a tree comes from it; so its no less improper to say, that the Worms in Mens Seed are Children, tho' Children come from them. Its

Its often said that a Tree may be seen in the Kernel of an Apple; but I must profess, that a Seed (laying aside the Radicle whence the Root springs) consists of roundish transparent Globules, which when it grows, turn into Cylindrical bodys, being Vessels to carry the nourishment to the Radicle, but when that is sufficient to draw its nourishment from the Earth, the remaining part of the Seed does no more service to the Plant, but dryes away. Tis true, when we examine severall Seeds, we find in them 2 or more beginnings of leaves, as small as a small Sand, these ly folded up, and shew in a Microscope like the Beak of a Sparrow, but when they are unfolded, we then see the beginnings of other leaves, which grow not till the root is bigger. These last Observations have been made on Seeds, just taken out of an Apple, or a little dried. But if you cut up a Turkey-bean, tho never so dry, the 2 leaves are visible to the naked Ey, but if you use a Microscope, you see the Ribs or Vessels of the leaves, for they are partly made to stiffen it, and partly to carry nourishment for its growth, &c.

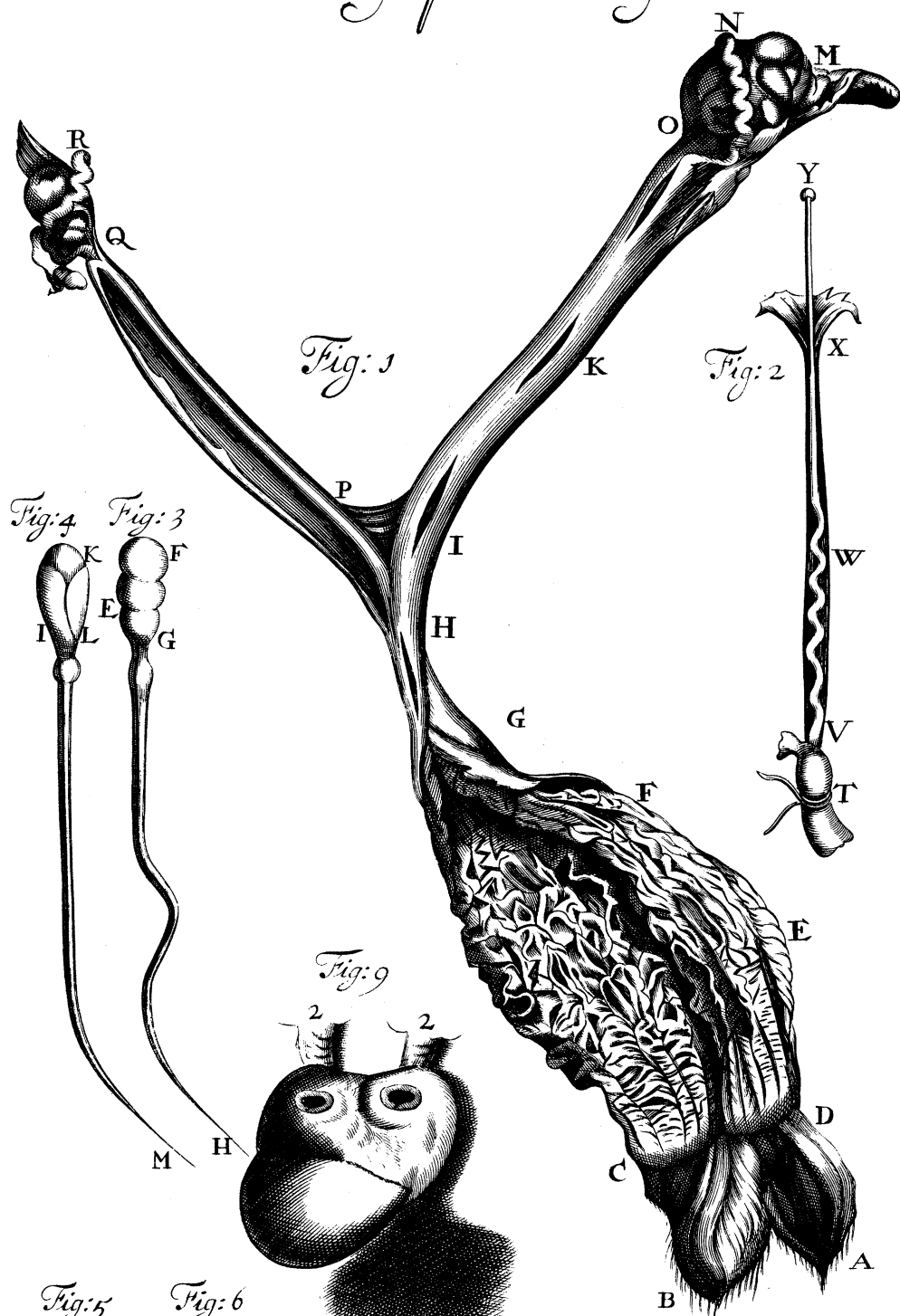
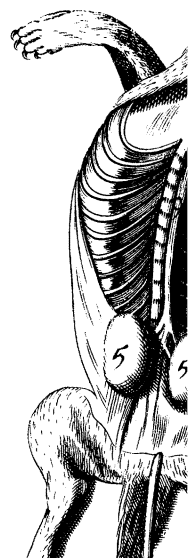
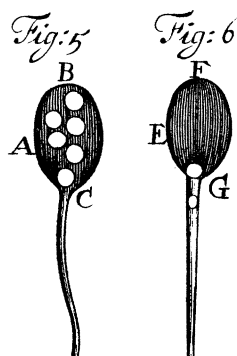
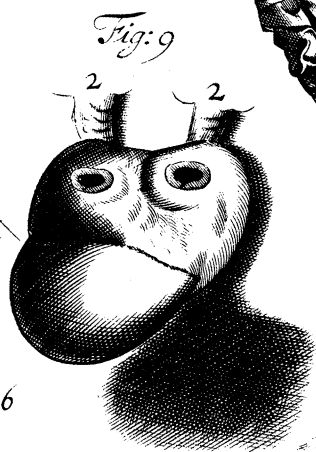
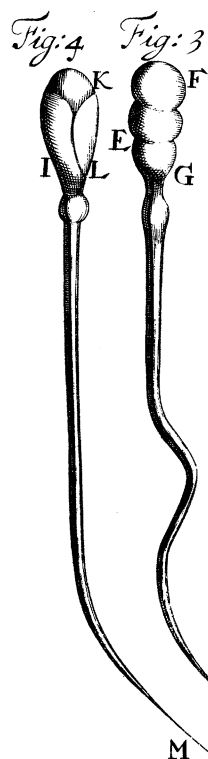
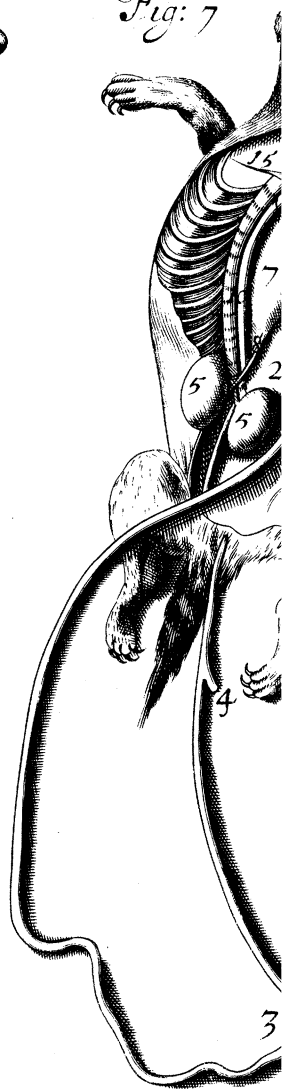


Fig: 7



4.

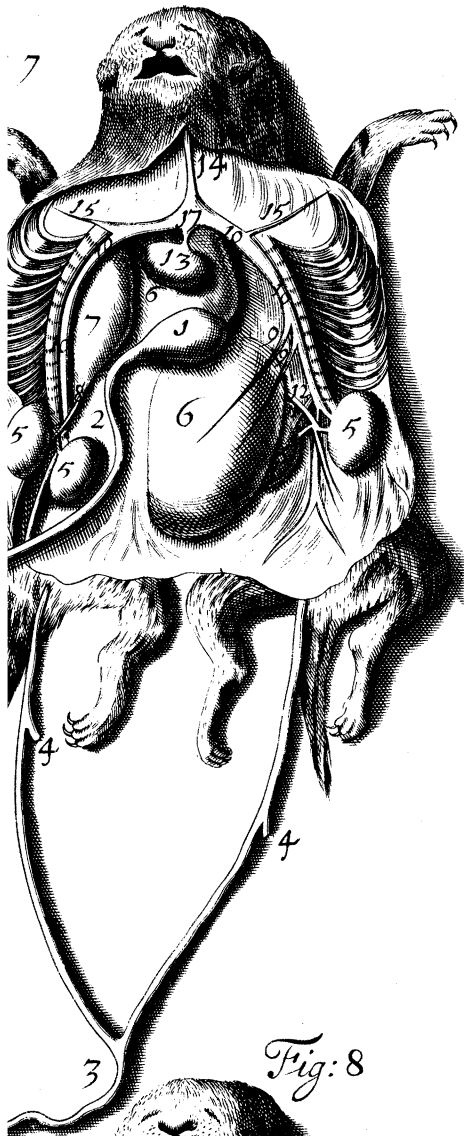


Fig: 8

